Anonymous Referee #2

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This paper presents a 5-month convection-permitting simulation for a very wide latitude band, from -57deg to 65deg. The authors compared the simulation results with observations/reanalysis and a simulation with coarse resolution, focusing on tropical precipitation, and teleconnection patterns. The authors concluded that the high-resolution simulation significantly improves the simulations of precipitation and will likely improve the seasonal forecast.

This paper is well-written and will be of interests to the modeling community. I would recommend publication if the authors can properly address the following comments.

We thank Referee #2 for the positive feedback and the valuable comments to further enhance the quality of the manuscript.

1. If I take a look at Figure 1, it is difficult to convince people that (a) and (b) are really alike. (b) might be improved from (c), but there is still a significant gap. This should be fully acknowledged.

   Thank you for your comment. We assume that your comment refers to Figure 2. Indeed the CP simulation shows some gaps with respect to the GPM precipitation observation. We reduced the strength of our findings statement so that the remaining differences are acknowledged.

   The end of section 3.1 on page 5, line 174 now reads:
   "Although larger differences between the CP simulation and GPM observations are still visible between 45° W and 90° W, the correspondence between the longitudinal and temporal structures between the GPM and the CP Hovmöller diagrams is improved compared to the NCP simulation."

2. In Fig. 2, the lower panel of the first column shows MJO signals, but I don't see them in the Hovmoller plot. Could you clarify? In the second column, the MJO signal is quite strong, which does not seem to be consistent with Fig. 1.

   We carefully checked all three Hovmöller diagrams in Figure 2 (we assume that this Figure is meant here). The Hovmöller diagrams of the daily precipitation amounts derived from GPM and from the NCP simulations are correct. For the CP simulation, we found a plotting error. Accidentally, we used 15° instead of 10 ° latitude for our NCL script to create the plot for the CP simulation, which is now corrected and Figure 2b is replaced. Now the CP simulation shows some structures transiting from west to east throughout the simulation period, which are also visible in the GPM observations.

   Although we see MJO like signals in the Wheeler-Kiladis diagrams shown in Figure 3, we cannot conclude that MJO signals are visible in the precipitation Hovmöller diagrams. As the GPM data set is mainly derived from microwave imagery from a low earth orbit (LEO) constellation, the satellites could miss some of the precipitation events.

3. There is a long history of why improved representation of small-scale convection can affect large-

scale tropical wave-like signals. For example, Mapes (2000, JAS) argued that multiple vertical modes are key to the development of equatorial waves, which are not often excited by traditional convection schemes. This theory was further developed by Kuang (2008, JAS). Khouider and Majda (2008, JAS) presented a multi-cloud model that explicitly simulates multiple vertical modes. That model produced an improved tropical wave spectrum. Yang and Ingersoll (2013, 2014) presented a shallow water model that can simulate the MJO and equatorial waves. The authors parameterized convection as a triggered process, as opposed to a quasi-equilibrium process, which is often used to parameterize convection in GCMs. The authors proposed that the intermittent trigger of convection is key to properly simulate tropical waves and the MJO.

Refs: Mapes, B.E., 2000: Convective Inhibition, Subgrid-Scale Triggering Energy, and Stratiform Instability in a Toy Tropical Wave Model. J. Atmos. Sci., 57, 1515–1535, https://doi.org/10.1175/1520-0469(2000)057<1515:CISSTE>2.0.CO;2

Kuang, Z., 2008: A Moisture-Stratiform Instability for Convectively Coupled Waves. J. Atmos. Sci., 65, 834–854, https://doi.org/10.1175/2007JAS2444.1

Khouider, B. and A.J. Majda, 2008: Multicloud Models for Organized Tropi- cal Convection: Enhanced Congestus Heating. J. Atmos. Sci., 65, 895–914, https://doi.org/10.1175/2007JAS2408.1

Yang, D. and A.P. Ingersoll, 2013: Triggered Convection, Gravity Waves, and the MJO: A Shallow-Water Model. J. Atmos. Sci., 70, 2476–2486, https://doi.org/10.1175/JAS- D-12-0255.

Yang, D., and Ingersoll, A. P. (2014), A theory of the MJO horizontal scale, Geophys. Res. Lett., 41, 1059– 1064, doi:10.1002/2013GL058542.

Although our focus is not on the representation of the MJO, we carefully checked your suggested references and decided to include the work of Yang (2013, 2014) into our manuscript, as convection is a triggered process in the applied cumulus parametrization.

According to Figure 1c of Yang and Ingersoll (2014), reducing the size of triggered convective events, which is in our case by increasing the horizontal resolution, helps to improve the prediction of potential MJO events. If we understand this figure correctly and assuming a horizontal grid increment of ~ 3 km, together with a Kelvin wave speed of 12 m s^{-1} (green circles in Fig. 1c of Yang and Ingersoll (2014)), and assuming that an NWP model is able to simulate features with 3-7 times the applied horizontal grid size, then the wave number would be about 2.5. This is in the range where the most power in the Wheeler-Kiladis Diagrams is contained.

The following sentence has been added to the summary section on page 9, line 319:

"According to studies of Yang and Ingersoll (2013, 2014), who analysed the Madden-Julian Oscillation (MJO; Madden and Julian, 1972) by applying a shallow water model, a WRF model resolution in the range of 5 km or higher is necessary to be able to represent MJO features assuming an effective WRF model resolution of seven times the horizontal resolution (Skamarock, 2004)."

4. Figures 4 & 7: it is difficult to define "improvement". It would be great if there is a way to quantify the performance.

Thank you for your valuable comment. We decided to add corresponding numbers for the regions mentioned in section 3.3. The corresponding sentence starting on page 6, line 211 now reads:

“Over Africa, the CP simulation shows a better agreement with the observations as compared to the NCP simulation with a bias reduction of 10 W m-2 to a total bias of 10 W m-2. The same applies to the Indian Ocean basin, where the NCP simulation shows, on average, 16 W m-2 less OLR than observed. Over the Atlantic and South America, the cloud coverage is considerably overestimated inside the ITCZ resulting in an OLR bias of 15 W m-2 and a strong precipitation bias in this area.”

Concerning precipitation, we found that the wrong Figures 6 and 7 have been inserted into the manuscript, which do not fit to the text in the manuscript. This is now corrected and the differences between the CP and NCP simulation during May 2015 becomes more clear.